

OBSERVATIONS ON THE ECOLOGY AND NATURAL
HISTORY OF ANURA XV. THE HYLIDS AND
MICROHYLIDS IN OKLAHOMA¹

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When the studies which are resulting in this series of papers were initiated, so little was known about the amphibian fauna of Oklahoma that the problems involved were attacked from practically all viewpoints at once. From the beginning, all phases in the lives in nature of any and all species present were observed at every opportunity rather than concentrating on any one phase or any one species first.

From necessity, this method has resulted in papers with several different emphases. Some have been largely ecological in nature; others have dealt with one species from the viewpoint of habits and distribution; while still others have been centered on some one phase of the lives of one group of species as contrasted with another in a different ecological community within the same general geographical range.

In general, problems in classification have been given little emphasis, for the taxonomic relationships of most of species in Oklahoma have been well worked out. An exception to this was found in the genus *Scaphiopus* and the paper on that group attempted a summary of classification as well as taxonomic relations expressed as a phylogenetic tree. The present paper constitutes another such exception, for its discussion includes one genus, *Pseudacris*, which has always been confused.

The conceptions expressed are based upon observations in Oklahoma during the past seven years (1936-1942 inclusive), modified in interpretation, of course, by a close study of all literature available. The paper deals with the hylid frogs primarily but includes observations upon the single microhylid present in the Oklahoma fauna, *Microhyla olivacea* (Hallowell).

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tangible and intangible. My greatest indebtedness is to my former colleague and collaborator, Dr. Chas. Clinton Smith, who worked with me during the earlier years in all parts of Oklahoma; to Dr. A. O. Weese for critical advice and suggestions particularly in ecological matters; and to Dr. A. I. Ortenburger for loans of literature, use of specimens, and criticism in herpetological matters.

TAXONOMY

The following taxonomic arrangement is the one adopted.

Class Amphibia

Order Salientia (Anura)²

Suborder Procoela

Family Hylidae

Subfamily Hylinae

Genus Hyla

1. *H. versicolor versicolor* Le Conte (1825)
2. *H. crucifer crucifer* Wied (1834)
3. *H. cinerea cinerea* (Schneider) (1799)

Genus Pseudacris

1. *Ps. clarkii* (Baird) (1854)
2. *Ps. triseriata* (Wied) (1838)
3. *Ps. streckeri* Wright and Wright (1933)

Genus Acris

1. *Acris crepitans* Baird (1854)

Suborder Diplasiochoela

Family Microhylidae

Genus Microhyla

1. *M. olivacea* (Hallowell) (1856)

In general, this follows the outline given by Stejneger and Barbour (1939) except in *Pseudacris* where my observations confirm those (e.g. Smith, 1934) who separated specifically *Ps. clarkii* (Baird) from both *Ps. triseriata* (Wied) and *Ps. nigrata* (Le Conte). The evidence for this view will appear later in the discussion.

KEY TO THE ADULTS OF THE ABOVE FORMS IN OKLAHOMA³

1. Toes with discs; webbing of hind toes varying in amount but always present; teeth in upper jaw.....2
1. Toes without discs; webbing and teeth absent...*Microhyla olivacea* (Hallowell)

² *Salientia* is clearly the preferred ordinal name; when the title of this series was chosen some years ago this was not recognized; accordingly the name *Anura* is retained in the title only for consistency, inasmuch as to change the title in the middle of the series would seem to be more confusing than the relatively minor point of using a less preferred, but easily understood, synonym.

³ Partly from the literature cited but modified by examination of several hundreds of specimens collected personally in Oklahoma.

2. Toe discs small and inconspicuous (*Acris* and *Pseudacris*).....3
2. Toe discs not particularly small and inconspicuous (*Hyla*).....6
3. Toes extensively webbed.....*Acris crepitans* Baird
3. Toes not extensively webbed (*Pseudacris*).....4
4. Body slim; nose pointed; hind legs long; fingers long.....5
4. Body short and toadlike; hind legs short; fingers quit short; nose rounded.....*Pseudacris streckeri* Wright and Wright
5. Color variable, typically gray or brown with dark stripes down the back, with a prominent light line along the jaw, and with no triangular mark dorsally behind the eyes (rare exceptions).....*Pseudacris triseriata* (Wied)
5. Color also variable, typically gray with small green or darker spots on back; either with no light line or only an inconspicuous one along the jaw; dorsal triangular mark back of eyes typical.....*Pseudacris clarkii* (Baird)
6. Size larger (37-63 mm.); color variable from nearly black to bright green, the green phase the usual one; no special X-like mark on back; skin smooth or only little roughened; a light line along upper jaw and extending about half way down side; body slim and hind legs very long*Hyla cinerea cinerea* (Schneider)
6. Size smaller (18-60 mm.); color also variable from nearly black to green but with gray coloration the usual one; skin tends to be granular; no light line along side; and X-shaped mark on back, present in most color phases7
7. Body size approximately 18-33 mm.; X-shaped mark, thin-lined and regular.....*Hyla crucifer crucifer* Wied
7. Body size approximately 32-60 mm.; X-shaped mark heavy-lined and often irregular in outline.....*Hyla versicolor versicolor* (Le Conte)

***Hyla versicolor versicolor* (Le Conte) (Common Tree Toad)**

The geographic range of *H. v. versicolor* is given by Stejneger and Barbour (1939) as, "Maine, southern Canada, west to Minnesota, south to the Gulf States and to Ocklawaka swamp in Florida. Texas and Arkansas in part only." Its range extends westward to eastern Kansas (Smith, 1934) and it is present in the central cross timbers of Texas where I have heard its call from oaks at night some forty miles north of Dallas while travelling U. S. Highway 77.

It has been known from eastern Oklahoma for some years but its extension westward within the state has been somewhat uncertain. I have specimens from each of the following counties which appear to be new records: Osage, Mayes, Garvin, Murray, Pontotoc, Love, Coal,

Atoka, Choctaw, Latimer, and Sequoyah. In addition, I have heard its characteristic call in Pittsburg, Huges, Seminole, and Carter counties, in all of which it apparently has not yet been collected. Adding the nine other counties in which it has been reported already to these new records gives a total of twenty-six counties, all in the eastern half of the state, in which the species is known to occur. Of this total, five records are based upon calls heard, twenty-one on specimens collected. Fifteen of the total are apparently new records.

In general terms, *H. v. versicolor* is dependent upon the presence of trees for a suitable habitat and usually the trees must be present in abundance. However, in Oklahoma it is common in dry woodlands and savannahs and not limited to ravines and water courses as might be expected from observations farther north and east (see Smith, 1934, and the literature cited there). Whereas the largest breeding congress of this species which I have ever seen was present along a wooded creek in southeastern Oklahoma, nevertheless, medium sized congresses have been frequently studied several miles from permanent water courses in dry woods about temporary pools. Flood plain forests of the larger rivers form a highway for its dispersal to the westward in southern Oklahoma (e.g. to western Garvin county along the Washita and at least to western Love county along the Red). But from McClain county northward these animals apparently fail to follow the rivers westward to any extent. In western Cleveland county, for example, they have never been found along the Canadian River where its flood plain forest extends westward into the mixed grass prairie, although they are very abundant only seven miles eastward across the prairie where the oak-hickory woodland-savannah begins (see Bragg, 1940, for a map of this region). On the other hand, stray individuals do follow wooded ravines into the prairie; one calling male was taken at a prairie pool, one mile from the western edge of the woodland and two others have been collected in Norman, four miles from the woodland-savannah.

The breeding habits of the common tree toad in Oklahoma are essentially as elsewhere. They begin breeding early in the spring (Bragg and Smith, 1942) and continue intermittently till midsummer, the exact dates usually depending upon rainfall. They, therefore, have a breeding season somewhat independent of rain for its beginning but are stimulated then as well as later by any rain which comes. They seldom call or breed at temperatures of 10°C. or below even after heavy rains in springtime.

The call has been described as variable. I find this to be true but have noted also that it tends to follow either one of two distinct patterns. One of these is a short, hoarse trill, varying in pitch among individuals and tending to be lower with increasing size. This is always given with the gular pouch extended and with little muscular movements of the abdomen and lateral regions. The other is a shorter, "fussy," "yip, yip, yip," etc., given without use of the gular pouch and with violent contraction of the body muscles with each note. The first type of call is the more common and may be heard from trees far from water as well as in breeding aggregations. The second is more often heard as a "protesting note" when the animal is confused or disturbed without being unduly frightened. However, one individual under observation which sat at the edge of a breeding pool "yipping" persistently, suddenly, and with no apparent reason, changed to the more typical short trill.

Wright (1929) stated that fully developed tadpoles of this form had a vermilion coloration to the tail fin. I have observed this on thousands of individuals taken or seen in Oklahoma. However, apparently no one has emphasized that the reddish color does not occur till late in aquatic life. Young tadpoles of *H. v. versicolor* when seen in their native pool look and behave so much like those of *Ps. streckeri* (Bragg 1942c) that one often cannot distinguish between them without close examination. They can always be distinguished in the field, however, if close attention be given to the coloration of the tail. That of *Ps. streckeri* always remains clear and essentially unpigmented. That of *H. v. versicolor* early develops black streaks, especially dorsally, which increase in numbers and may take the form of a dark fringe along the dorsal surface of the posterior part of the tail fin. The reddish color mentioned by Wright develops gradually during the last two weeks or so before metamorphosis at which time the tail appears higher and more ruffled than that of *Ps. streckeri*.

The young, after metamorphosis in Kansas stay, about pools and streams (Smith, 1934). In contrast, in Oklahoma I have never found them in such situations. In one case, for example, hundreds of thousands of tadpoles were being watched in a large pool among a heavy growth of oaks. On one visit in late June, 1942, it was apparent that most of them were approaching metamorphosis. A week later, no tadpoles could be found in the pool and a diligent search for an hour along the shore turning over objects and searching among the trees, failed to reveal a single specimen. From this experience, I thought it probable that the young animals had scattered widely in the trees

even though the weather was hot (90°F. and above each day) and the woodland extremely dry. One wonders how such young and delicate amphibians avoid death under such conditions as these.

***Hyla crucifer crucifer* Wied (Spring Peeper)**

The range of the spring-peeper given by Stejneger and Barbour (1939) includes nearly all of the South and East. Smith (1934) says that they are limited to the easternmost region of Kansas. They are present in Arkansas and Louisiana (I have seen specimens from the latter state) but Wright and Wright (1938) fail to mention this form in Texas.

In Oklahoma, they are known certainly from only one county, McCurtain, in the extreme southeast (Trowbridge, 1937) although I have had one report of their calls being heard in LaFlore county just north of this in the Ouachita mountains. In southern McCurtain county they seem to be fairly common, for nearly everyone from the University of Oklahoma who has looked for them on recent trips to this region has brought them in. Their abundance in southeastern Oklahoma in the Red River Valley makes it almost certain that they also occur across the river in Texas.

Their breeding season is apparently early in the spring here as elsewhere, because on trips in May and June to this region during and after rains when many other forms were calling, both Dr. Charles C. Smith and I have consistently failed to see them in breeding congregations.

***Hyla cinerea cinerea* (Schneider) (Green Tree Toad)**

This is a form of southeastern distribution which ranges westward to north central Texas (Wright and Wright, 1938). It enters Oklahoma only in the extreme southeastern corner, the only record being that of Trowbridge (1937). I, personally, have never collected it within the state.

***Acris crepitans* Baird (Northern Cricket Frog)⁴**

Acris crepitans has recently been separated from *A. gryllus* by Dunn (1938) on the basis of the extensiveness of webbing of the hind feet and upon other characters. Dunn also restricts the latter to the

⁴ *Acris gryllus* (LeConte) is known as the cricket frog because of its type of call. "Northern Cricket Frog," therefore, would seem to be an appropriate vernacular name for its northern relative whose call is also cricket-like.

southern coastal plain. All of the hundreds of specimens from Oklahoma which I have examined seem clearly to be *crepitans* in Dunn's key and also compare with specimens which I have collected in Wisconsin. Therefore, I conclude that all of the numerous records of cricket frogs in Oklahoma are *crepitans* and that *A. gryllus* does not occur in the state.

Interpreted in this manner, *A. crepitans* is statewide in distribution with the possible exception of the two western counties in the panhandle. In Kansas, Smith (1934) also found a cricket frog, called by him *Acris gryllus* (Le Conte), to be statewide. This undoubtedly is the same as *A. crepitans* of Oklahoma. The account of habits, habitat, and coloration as given by Smith are practically duplicated by my own observations in Oklahoma. Wright and Wright (1933) could not separate these two species with certainty but the same authors later (1938) mention only *Acris gryllus crepitans* Baird from Texas and declare it to be present from, "Sabine River to trans-Pecos; panhandle to southern Texas." More recently (1942) they have accepted Dunn's interpretation. Some of the southern or southeastern specimens in Texas may be *A. gryllus* but it is practically certain that the western and northern form in this state is the same as that of Oklahoma and Kansas, that is, *A. crepitans* Baird as separated by Dunn. I have collected typical *A. crepitans* in Somervell and Montague counties, Texas.

So many localities in Oklahoma are represented by specimens that it is simpler to list the counties where it has not specifically been taken or heard. These are Craig, Grant, McIntosh, Okfuskee, Johnston, Kingfisher, Dewey, Ellis, Texas, and Cimarron counties. It has been previously reported in forty-three Oklahoma counties, leaving twenty-four as new county records reported here. Of these, five (Cotton, Jefferson, Marshall, Blaine, and Noble) are based upon calls alone, the others on specimens collected personally or given me by others.

In a previous paper (Bragg, 1940) I reported that this frog had not been heard calling about buffalo wallows and apparently did not use these for breeding. I have since heard them twice in such places but neither time were tadpoles produced. I still doubt if they ever breed in buffalo wallows, although they feed about these pasture pools in some numbers, particularly in late spring.

Another detail of their habits is of interest. This is their marked tendency to wander at night between one creek or pool and another.

I have often found them in roadways during such movements. These movements occur at all seasons (except winter) to some extent but are most marked during two conditions: (1) in spring and early summer after rains and (2) in midsummer drought when pools and creeks are disappearing because of evaporation.

These little animals are quite frog-like in habits and habitat. They can be found active almost anywhere in Oklahoma where there is standing water, even in winter (except in severe weather). Every river, lake, creek, or cattle tank has its quota about its margin and their calls may be heard night and day from such areas. Most breeding is in midspring but may occur as late as September (Bragg and Smith, 1942). They are very agile but not particularly shy and are easily caught by hand if one takes advantage of their apparent dislike of deep water. If greatly frightened they may hide on the bottom after the manner of the commoner ranas. Usually, however, they jump to the water, swim rapidly back to the bank at another point, and depend upon their agility here to escape danger. Many of them fall prey to the larger frogs of their habitat and to shore-feeding birds such as herons. Presumably many are eaten by water-snakes also, but I have seen no specific instances of this. They feed on all sorts of insects present in their habitat and are surprisingly accurate in catching them by long quick jumps. I have seen one catch a damselfly with one jump of about four feet.

***Pseudacris streckeri* Wright and Wright**
(Texas Ornate Chorus Frog)

Since the life history and distribution in Oklahoma of this species has recently been given in detail (Bragg, 1942c) little need be added here. It is now known to be present in twenty-one Oklahoma counties from near the Kansas border to Texas. It is the earliest form to breed in Oklahoma (Bragg and Smith, 1942) and the earliest (except *H. c. crucifer*) to cease breeding activities. It feeds in pastures and along road sides at night during the warmer portions of the year, most often seen in these situations after rain. It has been taken from roadways after rains off and on from March to October. Since writing on its life history, I have made further observations which are of special interest.

In the earlier paper (Bragg, 1942c) it was pointed out that eggs are difficult to find during some years but quite abundant during others, although males may call lustily. In the spring of 1942, males were

calling from February to early May but no females were seen till after a very heavy rain (5.1 in.) at a near freezing temperature in early March. Notes taken that night in the field read, "*Ps. streckeri* females may be stimulated to seek males more vigorously by rain. The males have been calling for a long time and some eggs have been laid; however, tonight, a very large number of eggs are being produced and more females than I have ever before found at one time are in or near the pools." I saw several other such instances during April and could find no evidence against the conception expressed above.

These observations apparently explain why both Prof. G. A. Moore and I have had the impression that more breeding occurs during years of much winter rain.

***Pseudacris clarkii* (Baird) and *Pseudacris triseriata* (Wied)**
(Spotted Chorus Frog and Striped Chorus Frog)

The taxonomic relations of these two forms have been in confusion for a long time. Most eastern herpetologists relegate both forms to *Ps. nigrita* as subspecies. Some (e.g. Burt, 1932) consider *triseriata* to be specifically distinct from *nigrita* with *clarkii* as a subspecies of it. Wright and Wright (1933, 1938, 1942) recognize both forms as subspecies of *nigrita* and Stejneger and Barbour (1939) retain this arrangement without comment, thereby tacitly discounting the evidence of Smith (1934) that the forms are specifically distinct. In a recent communication to the author, a well-known American taxonomic herpetologist stated, "I can understand *clarkii* only as a subspecies of *nigrita* or *triseriata* and I suspect that in Oklahoma you have a single but variable form." On the other hand, another prominent worker, with much experience with this group, declared in a letter, "I know *triseriata* to be quite variable but I am certain that it is specifically distinct from either *clarkii* or *nigrita*." Under such circumstances, one can only present his evidence, draw his conclusions, and then hope that he has contributed something toward a solution of the difficulty rather than adding to it. Therefore, I shall write the remainder of this account of these two forms from my observations alone, taking no notice of the *opinions* of others; although, of course, I shall use their *observations* as published.

I begin by stating my general conclusions and follow this with the evidence for it. The two forms are specifically distinct and their adults can always be separated on the morphological characters given

by Smith (1934). My evidence (in addition to that given by Smith) that this is so can be summarized as follows:

(1) They occupy different habitats in Oklahoma. *Ps. triseriata* is primarily a form of the woodlands and lower, moister areas; *Ps. clarkii* is restricted to the prairies and to prairie islands in savannah. The former is very abundant all over the western half of Oklahoma and does not occur in the southeast at all. On a night after heavy rain in June, 1940, I traveled from central McCurtain county in the southeast to central Cleveland county in the central part of the State. Thousands of *Ps. triseriata* were calling (and several collected) everywhere till central Pontotoc county was reached. Then, suddenly, they became rare and within five miles had disappeared altogether. Simultaneously, calls of *Ps. clarkii* began to be heard, at first in the same pools with *triseriata*, but soon alone. From here on *clarkii* were calling from almost every ditch and puddle till daylight showed and finally stopped the chorus in McClain county. Similarly, in southwestern Oklahoma on several good breeding nights, I have never failed to hear and collect *clarkii* alone. In eastern Oklahoma, the same is true of *triseriata*.

(2) Their calls are different. I have heard both hundreds of times, sometimes together, but more often separately, and I have taken pains to see if I could tell the difference. Whenever I have had opportunity, I have identified the call before stalking the animal and, since my early experiences, have never failed to be correct. In one case, only one of each was calling in a pool. They were both together and I decided which was which before catching both simultaneously, one in each hand. Again, I was right.

(3) Their eggs and egg laying differ. With *Ps. triseriata* (Wells, 1924)⁵ eggs are laid on slanting vegetation (twigs in this instance) and in considerable numbers to a mass. Smith (1934) indicates masses of from 110-300 eggs, the mode about 140, but he quotes others who found less than this (see also Wright and Wright, 1933, 1942). With *clarkii*, the eggs which I have seen (hundreds of masses) have all been on *upright* vegetation and in small masses often as few as six, seldom more than twenty, usually on sedges or grasses, almost never on twigs.

The individual eggs of *triseriata* are brown, or black, and white (Wright and Wright, 1933); those of *clarkii* always brownish-gray, shading to white at the vegetal pole. The egg-complement of *triseriata*

⁵ Presumably this species if taken at Chicago, as implied.

is 500-800 (Wright and Wright, 1933). That of *Ps. clarkii* in one case was 916 by my individual count and dissection of several females showed the ovaries with large numbers of eggs indicating that the usual number is large. Measurements of individual eggs of *clarkii* indicate a mean diameter of 1.04 mm. with a mode of 0.959 but with variation so great as to be noticeable with the naked eye. This egg size is comparable to that of *Ps. triseriata* but the variation in *clarkii* appears to be greater.

(6) Their tadpoles differ in many details. That of *triseriata* apparently is somewhat variable in different areas (unless other tadpoles have been confused or unless the species has unrecognized subspecies of which there is some evidence; see beyond). Wright and Wright (1933) indicate a small (23 mm.), dark, bronzy tadpole, full-bodied, with a long-tipped tail, and with tooth ridges 2/2. Youngstrom and Smith (1936) give evidence of a 30-32 mm. grayish tadpole, tail tip obtusely rounded but somewhat attenuated at the end, and a labial formula of 2/3.

The tadpole of *Ps. clarkii* has not been studied in detail (see, however, summary by Wright and Wright, 1942). I have studied it during two seasons now, both from pairs taken from congresses and reared in the laboratory, and in the field. All stages have been studied from egg-laying to metamorphosis. Details will be given later in a separate paper. This tadpole differs from *triseriata* as follows: (1) lighter in color; (2) larger at hatching (3.9-4.7 mm. as compared to 2.5-3.0); (3) motile at hatching instead of premotile (Youngstrom and Smith); (4) details of color pattern; (5) details of mouth parts; and (6) behavior and appearance at and after metamorphosis (I have seen both species of these and collected and watched them about native pools); young of *clarkii* remain about pools for some weeks, those of *triseriata* leave within a few days; young *clarkii* are agile and difficult to catch by hand, *triseriata* much less so; young of *clarkii* begin to be spotted, including the large conspicuous triangular spot back of the eyes emphasized by Smith (1934), before the tail is completely gone; *triseriata* become striped at about the same stage (Youngstrom and Smith, 1936, fig. 7), but this varies among individuals, some not showing the characteristic dorsal markings till a few days later; *clarkii* is very long and slim bodied when just out of the pool; *triseriata* is more heavily built, more round-nosed, and appears heavier and more bulky. (This correlates nicely with the difference in agility noted above.)

(7) I find little evidence recorded tending to show intergradation

of taxonomic characters indicative of subspecific identity of *triseriata* with *nigrita*.⁶ Their ranges meet in the middle south and intergradation may later be shown to occur there. In the case of *clarkii*, intergradation with *nigrita* is clearly an impossibility; for, the former's range does not come anywhere near that of the latter. If the criterion of subspecies be primarily the presence of intergradation of characters along the zone where the ranges of two forms meet (the usual concept) it is obvious that *clarkii* can not be a subspecies of *nigrita*. The relation between *clarkii* and *triseriata* is not so clear-cut, however. As already indicated, the former is the prairie form in Oklahoma; the latter, primarily the woodland and savannah form. *Triseriata*, however, is not limited to its characteristic habitat, for I have seen it rarely in the tall grass prairie of northeastern Oklahoma, in the shortgrass plains of the Texas panhandle, and in the valley of the Gallinas Creek at Las Vegas, New Mexico (also in short-grass country), and very rarely in mixed-grass prairie at Norman, Oklahoma (Bragg, 1942b). Burt (1936) says that intergradation occurs in southern Kansas and perhaps in eastern Texas, which is contrary to the opinion of Smith (1934). If intergradation were to occur both in southern Kansas and eastern Texas, one would certainly expect it in east central Oklahoma in a marked zone, running approximately north and south through the state. I find no such zone, even though I have collected all over the area where it should occur. As explained earlier, animals taken from breeding congresses (whether when only one or both are present in the same pool) are always clearly the one or the other, both in morphological characters and in call. *Ps. clarkii* sometimes tends to be striped rather than spotted; *triseriata* spotted rather than striped. This is not evidence for intergradation along a zone where ranges meet because I have taken many spotted *triseriata* east of the range of *clarkii* in Oklahoma (e.g. in eastern McCurtain county, near the Arkansas line) as well as far west of the range of *clarkii* (one at Las Vegas, N. M.). Similarly, striped *clarkii* are no more abundant in east central Oklahoma than farther west in the state. About Norman, just west of the area where the *triseriata* abundance stops, both spotted and striped *clarkii* are present, the spotted ones the more numerous. There is no difference in the calls of these two variants.

The situation seems to be, therefore, one in which a very wide

⁶ It should be noted, however, that this is the weakest point in my argument for I have never studied *Ps. nigrita* alive nor seen it breed. I also suspect that I may have missed some of the literature.

ranging, variable species (*triseriata*) has its range crossed by that of a related, but distinctly less variable species (*clarkii*), the first species being present only locally, and seldom in abundance within the range of the second, which, therefore, largely but not completely, replaces the first. This situation is clearly correlated with the ecological divisions of the area in question, *clarkii* being the abundant form in the mixed-grass and eastern portions of the short-grass prairies, whereas *triseriata* is the form of the woodland-savannah to the east and north and the short-grass plains (in local situations) to the west. The species meet and overlap slightly in the tall-grass prairie of Kansas, Oklahoma, and possibly Texas; and also (with less overlap) in the open savannahs of southeast central Oklahoma.

Ps. triseriata (as here interpreted) has formerly been reported from five Oklahoma counties (McCurtain, LeFlore, Lincoln, Tulsa, and Cleveland). I now have specimens from Choctaw, Latimer, Atoka, Seminole, Washington, and Mayes, and have recognized the call in Pushmataha, Coal, Pontotoc, Oklahoma, Rogers, and Seminole counties in addition. It is, therefore, now known from sixteen counties, all in the eastern half of Oklahoma.

Ps. clarkii has been previously reported in from thirteen counties. Additional records based on specimens seen are Washington, Garfield, Noble, Logan, Blaine, Greer, Jefferson, Love, Marshall, Johnston, Murray, Garvin, and Seminole counties, with call records in Kingfisher county in addition. This makes a total of twenty-six counties in which *Ps. clarkii* is now known to occur, all in the western two-thirds except in the Osage prairies (tall grass) of the northeast.

Variations in *Ps. triseriata*, while not particularly toward *clarkii*, are nevertheless marked. In southeastern, eastern, and central Oklahoma the coloration is darker than in the northern part of the state where they more closely resemble the specimens which I have seen from Kansas.⁷ Then, there is a peculiar variation in call. Dr. Charles C. Smith collected specimens of *Ps. triseriata* at Monroe, Louisiana which he turned over to me for study. In his notes he says the call appeared higher in pitch than that of *triseriata* which we had heard together in Seminole county, Oklahoma. Later, he demonstrated this to me in southeastern Oklahoma.

In McCurtain, Choctaw, and Atoka counties, most of the calls were of a high pitch; some lower. As we came northwestward, calls of both types came from the same pools and ditches more frequently

⁷ Through the courtesy of Dr. Edw. H. Taylor of the University of Kansas.

till the higher call began to drop out in southeastern Pontotoc county (only a few miles east, incidentally, of where the westernmost *clarkii* were heard). All specimens west of this area had the hoarser calls, like those heard earlier by us together in Seminole and Oklahoma counties and by me in Cleveland county. Specimens calling in each manner from the same pool were stalked and captured but I could find no consistent morphological differences between them. Dr. Smith was certain that the higher pitched call was identical with those heard by him in Louisiana. We were agreed that the lower pitched one was identical with that heard by us together in several other places in Oklahoma and which I identified as the same as that heard by me at Las Vegas, N. M. It is interesting to note that tadpoles produced from eggs laid by the specimens in Louisiana and given me by Dr. Smith conformed very closely to the characters given for this larva by Wright and Wright (1933) except that the labial formula was $2/3$ instead of $2/2$. This was a much darker tadpole than that of the Kansas form studied by Youngstrom and Smith (1936); in fact, it was almost black; and, after metamorphosis, the young were very much darker than those which I have seen emerging from pools in central Oklahoma. These facts suggest that at least two (maybe more) races, ecads, varieties, or subspecies of *Ps. triscriptata* may occur which are at present unrecognized. Only further study of life histories from known parents in the critical areas will clear up the matter.

Microhyla olivacea (Hallowell) (Texas Narrow Mouth Toad)

*Microhyla olivacea*⁸ occurs from northern Mexico north through Kansas, east to western Arkansas and Missouri (Smith, 1934; Anderson, 1942). No one seems to know how far westward its range extends. In Oklahoma it is statewide and abundant except, possibly, in western part of the panhandle. I have collected in many parts of the state and have found no other species of the genus here. Therefore, I conclude that the several Oklahoma records of *M. carolinensis* were all based upon this species. Including these, *M. olivacea* has previously been reported from twenty-one Oklahoma counties. My new records are based on specimens from Kay, Tulsa, Latimer, Choctaw, Atoka, Pittsburg, Hughes, Coal, Pontotoc, Murray, Carter, Love, and McClain counties. Dr. Chas. C. Smith has seen it also in Harper county which is the only record in the northwestern part of the state.

⁸ Still called *Gastrophryne olivacea* by those who emphasize the distinctiveness of the American genera from those of the Old World. See Stejneger and Barbour (1939). Wright and Wright (1933) use *Gastrophryne*, later (1938) they use *Microhyla* but now (1942) return to *Gastrophryne*.

Thus, *M. olivacea* is known to occur in approximately half (35 out of 77) of the Oklahoma counties with little if any ecological restriction in habitat. It is, however, rarely if ever found on extensive flood plains of rivers.

Its habits in Oklahoma are essentially as described by Smith (1934) in Kansas and need not be reviewed specifically here. (See also earlier notes in papers by the author and his associates.) I should like to emphasize a few observations on its breeding, however, which either have not been sufficiently stressed or not published earlier.

(1) It exhibits the xeric breeding pattern characteristic of prairie-limited species in Oklahoma (see Bragg, 1942e for details of this pattern.) It breeds only after rain when the air temperature is relatively high; and it will breed after any rain sufficient to fill temporary pools from late April to September. Therefore, it has no breeding season (except in so far as the whole late-spring-to-early-fall period may be considered one).

(2) Males often call close together in grass clumps. I have seen them many times in twos, threes, and fours, in single clumps of protruding vegetation when there was no apparent environmental reason for it. So close do they approach each other that I have several times caught two with one plunge of the hand, despite the fact that this is one of the most difficult frogs known to me to catch (or to hold after one has caught it). This suggests strongly that the males are attracted by each other's calls, a factor characteristic of the xeric breeding pattern.

(3) The males commonly call from shallow water either near the edge or all over the pool; but mated pairs and (later) eggs are almost always seen near the bank. Females approach males whenever they are calling in the pool and mating probably takes place at the male's calling station. It follows that the newly mated pairs, if not already near the bank, swim to this for egg laying. I have seen females approach calling males on several occasions but never have succeeded in actually seeing a natural mating.

(4) The call of this species varies more than commonly supposed. Most individuals give a slight and very short "peep" followed by a high pitched buzz (Wright and Wright, 1933). Some open without the peep and have a deeper buzz. In general, it is the larger males which have the deeper voices but some with deeper voices open with the peep and some with shriller voices do not. So far as I can tell, these are individual variations, for I have never heard an individual change its note.

SUMMARY

The family Hylidae is represented in Oklahoma by three genera, *Hyla*, *Acris*, and *Pseudacris*. The first includes *Hyla v. versicolor*, *H. c. crucifer*, and *H. cinerea cinerea*; the second, *A. crepitans*; the third, *Ps. streckeri*, *Ps. triseriata* and *Ps. clarkii*. The family Microhylidae is represented by only one species, *Microhyla olivacea*.

Most of these are distributed in accordance with major ecological divisions of the state. *H. v. versicolor* occupies the eastern half (in woodland and savannah) but follows the flood plains forests of the larger rivers westward in the southern part of Oklahoma. *H. c. crucifer* and *H. c. cinerea* are known only in the low, swampy areas of the Red River Valley in southeastern Oklahoma. *Ps. streckeri* is known in a broad zone running north and south through Oklahoma from near Kansas to Texas. It is abundant in the mixed grass prairie and oak-hickory woodland-savannah of this zone but has not been found in either tall or short grass prairies to the southeast and west respectively. It is very abundant on flood plains of the larger rivers within the zone designated. *Ps. clarkii* is the species of the prairies, *Ps. triseriata* the species of the woodland-savannah of Oklahoma. The former, therefore, is restricted to the western half of the state except in the northeast where its greatest eastern extension occurs in the western edge of the tall-grass prairie. *Ps. triseriata* is abundant in the eastern third of Oklahoma, especially in the southeast, but it inhabits small suitable areas west to the Rockies. It has, however, not been specifically taken in western Oklahoma. Reasons are given for recognizing these two forms as specifically distinct. *Microhyla olivacea* is probably state-wide in distribution, although unknown in the Oklahoma panhandle. While ecologically unrestricted, it exhibits a xeric type of breeding pattern characteristic of the prairie-limited species.

Specific county records of all of these species and notes on the habits of several of them are given in the text.

BIBLIOGRAPHY

- Anderson, Paul, 1942. Amphibians and reptiles of Jackson County, Missouri. Bull. Chicago Acad. Sci. 6:203-220.
- Blair, A. P., 1941. Isolating mechanisms in treefrogs. Proc. Nat. Acad. Sci. 27:14-17.
- Black, John D. and S. C. Dellinger, 1938. Herpetology of Arkansas Pt. 2. The Amphibians. Occa. Papers Univ. Arkansas. Mus. 2:3-30.

- Bragg, Arthur N., 1940. Observations on the ecology and natural history of Anura. III. The ecological distribution of Anura in Cleveland county, Oklahoma, with notes on the habits of several species. *Amer. Midl. Nat.* 24:322-335.
-, 1940a. Observations etc. V. The process of hatching in several species. *Proc. Okla. Acad. Sci.* 20:71-74.
-, 1941. Observations etc. VIII. Some factors in the initiation of breeding behavior. *Turtlox News* 19:10-12.
-, 1941b. New records of frogs and toads for Oklahoma. *Copeia* 1:51-52.
-, 1941c. Some observations on amphibians at and near Las Vegas, New Mexico. *Great Basin Nat.* 2:109-117.
-, 1942. On toad and frog abundance after heavy rainfall. *Science* 95:194-195.
-, 1942a. Further notes on the initiation of breeding behavior of Anura. *Turtlox News* 20:12-13.
-, 1942b. Corrected list of Amphibia known in central Oklahoma. *Proc. Okla. Acad. Sci.* 22:16-17.
-, 1942c. Observations on the ecology and natural history of Anura X. The breeding habits of *Pseudacris streckeri* Wright and Wright in Oklahoma, including a description of the eggs and tadpoles. *The Wasmann Collector* 5:47-62.
-, 1942d. Observations etc. XI. The invasion of the Canadian River flood plain by two prairie species. *Proc. Okla. Acad. Sci.* 22:13-14.
-, 1942e. Observations etc. XII. The spadefoot toads in Oklahoma with a summary of our knowledge of the group. *Amer. Nat.* (in press).
- Bragg, Arthur N. and Charles C. Smith, 1942. Observations etc. IX. Notes in breeding behavior in Oklahoma. *Great Basin Nat.* 3:33-50.
- Burt, Charles E., 1931. A report on some amphibians and reptiles from Kansas, Nebraska and Oklahoma. *Proc. Biol. Soc. Wash.* 44:11-16.
-, 1932. Records of amphibians from the eastern and central United States (1931). *Amer. Midl. Nat.* 13:75-85.
-, 1935. Further records of the ecology and distribution of amphibians and reptiles in the Middle West. *Amer. Midl. Nat.* 16:311-336.
-, 1936. Contributions to the herpetology of Texas I. Frogs of the genus *Pseudacris*. *Amer. Midl. Nat.* 17:770-775.

-, 1938. Frogs and toads of southeastern United States. Trans. Kans. Acad. Sci. 41:331-366.
-, 1938 a. Contributions to Texas herpetology VI. Narrow-mouthed froglike toads (*Microhyla* and *Hypopachus*). Paps. Mich. Acad. Sci., Arts, and Letters 23:607-610.
- Burt, Charles E. and May Danheim Burt, 1929. A collection of amphibians and reptiles from the Mississippi Valley, with field observations. Amer. Mus. Novits. #381: 14 pp.
- Brennan, L. A., 1937. A study of the habitat of the reptiles and amphibians of Ellis county, Kansas. Trans. Kans. Acad. Sci. 40: 341-345.
- Dunn, Emmett Reid, 1938. Notes on frogs of the genus *Acris*. Proc. Acad. Nat. Sci. Phila. 90:153-154.
- Ortenburger, A. I., 1926. A report on the amphibians and reptiles of Oklahoma. Proc. Okla. Acad. Sci. 6:89-100.
-, 1926a. Reptiles and amphibians collected in the Wichita Mountains, Comanche county, Oklahoma. Copeia #155:137-138.
-, 1926b. Reptiles and amphibians collected in the Arbuckle Mountains, Murray county, Oklahoma. Copeia #156:145-146.
-, 1927. A list of amphibians and reptiles from the Oklahoma Panhandle. Copeia #163:46-48.
-, 1929. Reptiles and amphibians from southeastern Oklahoma and southwestern Arkansas. Copeia #170:8-12.
-, 1930. Reptiles and amphibians from Pawnee county, Oklahoma. Copeia #173:94-95.
- Ortenburger, A. I. and Beryl Freeman, 1930. Notes on some reptiles and amphibians from western Oklahoma. Publ. Univ. Okla. Biol. Surv. 2:175-178.
- Smith, Hobart M., 1934. The amphibians of Kansas. Amer. Midl. Nat. 15:377-528.
- Stejneger, L. and Thomas Barbour, 1939. A checklist of North American amphibians and reptiles. Ed. 4 XVI + 207 pp. Harvard Univ. Press.
- Trowbridge, A. H., 1937. Ecological observations on amphibians and reptiles collected in southeastern Oklahoma during the summer of 1934. Amer. Midl. Nat. 18:285-303.
-, 1937a. New records of Amphibia for Oklahoma. Copeia 1:71-72.
- Walker, Charles F., 1932. *Pseudacris brachyphona* (Cope) a valid species. Ohio Jour. Sci. 32:379-384.

- Wells, M. M., 1924. *Chrophilus nigrinus*. The swamp tree frog. *Turtlox News* 2:22.
- Wright, A. A. and A. H. Wright, 1933. Handbook of frogs and toads. XI + 231 pp. Comstock Publ. Co., Ithaca, N. Y. (See also 2nd ed., 1942).
- Wright, A. H., 1929. Synopsis and description of North American tadpoles. *Proc. U. S. Nat. Mus.* 74(Art. 11):1-70.
- Wright, A. H. and A. A. Wright, 1938. The amphibians of Texas. *Trans. Tex. Acad. Sci.* 21:5-36.
- Youngstrom, Karl A. and Hobart M. Smith, 1936. Description of the larvae of *Pseudacris triseriata* and *Bufo woodhousii woodhousii* (Anura). *Amer. Midl. Nat.* 17:629-633.